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PHYSICAL REQUIREMENTS AND CAPITAL COSTS FOR ESTABLISHING FIELD NURSERIES FOR U.S.D.A. PLANT HARDINESS ZONES FIVE AND SIX

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INTRODUCTION

A cost model for production of crops representing five categories of field-grown production schemes in U.S.D.A. Plant Hardiness Zones Five and Six was developed. Physical coefficients are included so the information can be readily updated and so individual nurserymen can use the model as a standard against which to compare their own operation or planned operation. Information derived should provide a basis for decision-making for those evaluating the necessary physical and capital requirements in either establishing a new field nursery, expanding an existing field nursery or phasing out of field production.

Comprehensive cost models have recently been developed for container grown crops in U.S.D.A. Plant Hardiness Zone 6 (3), for field grown crops in U.S.D.A Plant Hardiness Zones 7 and 8 (1), and for field grown crops in U.S.D.A. Plant Hardiness Zones 5 and 6 (2). This paper presents physical requirements and capital expenditures for establishing the 200 acre field nursery analyzed in the latter study.

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OBJECTIVES

The general objective of this paper was to develop the physical and capital requirements of a model field production facility. Specific objectives were to:

1. Design physical facilities including land areas, land improvements, irrigation systems, buildings, machine and equipment components for a 200 acre commercial field nursery based on model production systems delineated in a companion article entitled "Field Nursery Overview - Size, Systems, and Enterprise Mix in U.S.D.A. Plant Hardiness Zones Five and Six".
2. Determine capital costs for the above physical facilities.

MATERIALS AND METHODS

This paper is based on a firm synthesized using the conceptual framework of economic engineering wherein the "best proven practice" was included. It was synthesized based on the North Central region. If specific items were required (i.e. depth of the well), coefficients were based on the Columbus, Ohio area. The complete model included developing an appropriate production cycle; schematic drawings of the physical layout, including buildings and irrigation system; lists of equipment and other items; a complete sequence by month and year of nursery operational steps beginning with land preparation and ending with loading the finished product for wholesale distribution (2).

Data for this study were obtained from wholesale nurseries

and nursery suppliers in the North Central region during the late Autumn and Winter of 1984 and the Spring of 1985. Price quotations obtained were for the 1985 production season. The basic goals in synthesizing the production facilities were to minimize labor expenses, flow and movement of plant material and equipment, water runoff, maximize the number of salable plants and allow future expansion.

The nursery reported in this paper included 170 acres of growing space and 30 acres of production facilities, holding area, field bed area and roads.

Physical Plant and Equipment

Assumptions

Assumptions about the physical facilities and equipment can greatly affect its cost and thereby cost per salable plant. The authors included all items a nursery would typically require, thus the physical plant is probably more elaborate than many nurserymen would require. A nurseryman can easily eliminate or reduce items as required. However, it would require substantial effort to do the analysis on his own if they were not included.

Components

Land Improvement. For full utilization of the production facilities, holding area, and field-bed area; extensive grading, gravelling, surface and underground drainage tiles were provided. Liner bed areas and general field production were tiled with 4" plastic tile, 30' on center, 42" deep using a herringbone design. For any area that heavy equipment may run over (shipping area and

machine storage shed), #4 gravel was used. In other graveled areas, #8 grade was utilized. Although the cost of this graveling operation is high, it is offset by greater efficiencies and dependability in the handling of plants, ability to reenter the areas after natural or artificial irrigation and reduction of soil erosion.

A pond was included even though it was assumed a well could be dug with sufficient regenerative water capacity. This was done to reduce the risk to plants while in holding areas in case of disruptions caused by repairs or electrical failure. An auxiliary take-off drive from the pump could be powered by a large 75 HP tractor for temporary irrigation.

Buildings. Permanent buildings were provided for the receiving of nursery stock/storage (50' x 40'), machinery repair/storage (50' x 40'), office space (20' x 20'), and restroom facilities (20' x 20').

Propagation facilities. For propagating the three classes of shrubs, a full 20' x 200' polyhouse would be utilized. This propagation area was equiped with a double polyethylene cover and heating equipment.

Overwintering facilities. Twenty polyhouses (20' x 200') were provided to overwinter 1/4 of a years harvest.

Machinery and Equipment. Purchase of new machinery and equipment was assumed for the model nursery to achieve true replacement costs. Many nurserymen may choose to buy used equipment, rent equipment or time-share some expensive items with

other nurseries.

Irrigation system. Irrigation systems were designed to minimize labor efforts and plant loss risk, yet provide sufficient irrigation capabilities to meet present and future water needs. The basic irrigation system was composed of four parts: water source, pumping equipment, inground irrigation pipe, and above ground irrigation pipe and materials.

The water source must have adequate reserves to meet maximum water needs and sufficient purity to meet cultural requirements. Because municipal water is expensive, especially if the production site is located far from a center of population; a well in conjunction with a constructed lake or a site situated near an open water source of high quality water would be desirable. Our model assumed an adequate water source found approximately 60 feet below ground. The well was dug to a depth of 80 feet to ensure adequate recharging capacity. In some areas of USDA Plant Hardiness Zones 5 and 6, wells would have to be drilled to much greater depths which would result in higher costs.

Selection of a well pump is crucial to the nursery operation. An electric motor was chosen because of realibility of performance, low maintenance cost and close availability of three-phase electrical power.

The third part of the irrigation system is the in-ground irrigation pipe. The advantages of inground water mains are: labor costs for pipe movement is eliminated, breakage due to

equipment running over above ground pipe is eliminated, and lower initial cost of P.V.C. pipe compared to portable above ground aluminum.

The fourth part of the irrigation system would be above ground and would include frost free hydrants. Three inch, portable, latchless, aluminum portable pipe was provided for irrigation within the central area. Rotating #30BH rainbird sprinklers were provided for dispersing water in the central area. A traveler gun with a dispersion rate of 450-500 gallons per minute was provided for irrigating the grow-out areas.

Enterprise mix. We assumed that the model nursery would produce a diverse line of nursery stock. The length of the production cycle for the different species grown will vary. Commonly grown nursery stock were divided into five cultural groups. While not all inclusive, the groups do permit a range of per unit costs to be developed as they relate in input costs and cultural factors. For analytical purposes, we assumed that each cultural group would occupy 20% of the growing area (34 acres per group).

RESULTS AND DISCUSSION

Capital Investment Requirements

Capital investment requirements for establishing field nurseries were itemized under three broad divisions: land and improvements, buildings, and machinery and equipment (Tables 1). Each was further divided into several components. The nursery

had an initial investment requirement of $1,379,236. Land and land improvements represented 50% or $684,210 of the investment, buildings 12% or $165,981, and machinery and equipment 38% or $529,045.

An important consideration for managers in most industries is determination of investment per unit of production capacity. For field nurseries this indicator would be the capital requirement per-salable-plant capacity. To determine this figure it was necessary to determine how many salable plants would be produced annually for each group in its allocated 20% of the growing space. This quantity ranged from a low of 8,177 for Group IV (Acer Rubrum) to 25,418 for Group III (Forsythia & Viburnum). The number of plants grown per unit of space directly relates to the capital requirements per-salable-plant. These capital costs differentiated by plant group were figures were: $15.19 for Group I (Taxus), $10.85 for Group II (Junipers), $10.16 for Group III Forsythia & Viburnum), $33.73 for Group IV (Acer Rubrum), and $23.07 for group V (Malus). The average for all groups was $15.18.

Although investment requirements for a cost model field nursery for U.S.D.A. Plant Hardiness Zones 5 and 6 conditions were examined, an infinite number of sizes could have been analyzed. Examination of the data indicate higher investment costs per unit of salable plant capacity would incur as field nursery size is decreased from the 200 acre one analyzed. This would be caused by spreading the cost of fixed items such as

buildings, equipment, and machinery over fewer units. Conversely, lower costs per unit of salable plant capacity would be realized for field nurseries larger than the 200 acre nursery analyzed as the costs of fixed items would be spread over more units.

Individual nurserymen could, of course, incur somewhat different costs than those presented. Individual costs would depend upon variables such as production cycle chosen, labor productivity and ability to bargain with suppliers. The nurseryman also may choose not to provide for future expansion, choose land that would require minimum drainage modifications, reduce optimal growing/overwintering space requirements, rent land and/or equipment, and/or operate used equipment. This analysis assumed average soil conditions, expansion capacity, optimal spacing configurations, new buildings, equipment and machinery.

LITERATURE CITED

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TABLE 1.--Capital Requirements for a 200 Acre* Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item	Description	Unit	Useful Life (years)	Quantity	Cost per Unit (dollars)	Total Cost (dollars)	Percent of Total Cost
Land	Unimproved land	acre	--	200	2,000	400,000	29
+ Improvements	Grading, tiling, graveling, pond		20			284,210	21
Subtotal						684,210	50
Buildings							
Office and restrooms	20′ x 40′	sq ft	20	800	35	28,000	2
Plant and supply storage	40′ x 50′	sq ft	20	2000	20	40,000	3
Machinery storage and shop	40′ x 50′	sq ft	20	2000	20	40,000	3
Polyhouse structures	200′ x 20′	each	10	21	2,761	57,981	4
Subtotal						165,981	12
Machinery and Equipment							
Tractor, 75 HP	75 HP, diesel fuel	each	10	1	28,278	28,278	2
Tractor, 60 HP	60 HP, diesel fuel	each	10	1	20,419	20,419	1
Tractor, 34 HP	34 HP, gas fuel	each	10	4	14,504	58,016	4
Articulated 4-Wheel Drive Loader	Swinger 220 - Lift cap. = 2,000 lbs.	each	10	2	25,000	50,000	4
Articulated 4-Wheel Drive Loader	Swinger 320 - lift cap. = 3,000 lbs.	each	10	2	38,000	76,000	6
Tree spade	530P Handles 20",22", & 24" + liftpads	each	2	2	8,490	16,980	1
Forks	For front-end loaders	each	10	4	1,100	4,400	**
Plow	3-14 inch plows	each	10	1	2,616	2,616	**

Table 1 Cont.

Disk	8′ wide	each	10	1	3,900	3,900	**
Harrow	10′ wide	each	10	1	650	650	**
Cultimulcher - bed area	10′ wide	each	10	1	3,800	3,800	**
Sprayrig (boom sprayer)	100 gallon tank with 7′ & 10′ booms	each	7	1	1,407	1,407	**
Transplanter, 3 row	3-20 inch row bed transplanter	each	10	1	7,500	7,500	1
Transplanter, 1 row	Tree planter	each	10	1	5,000	5,000	**
Permanent irrigation/well pump	100HP electric pump	each	20	1	36,396	36,396	3
Inground irrigation/bed area	PVC pipe/valves		20		34,606	34,606	3
Above ground irrigation/bed area	Aluminum pipe/valves/sprinklerheads		5		4,347	4,347	**
Inground irrigation storage/holding	PVC pipe/valves		20		17,959	17,959	1
Above ground irr. storage/holding	Aluminum pipe/valves/sprinklerheads		5		8,286	8,286	1
Traveler gun - field irrigation	450-500 gallons per minute		10	1	22,000	22,000	2
Portable irrigation pump	40 HP P.T.O irrigation pump/foot valve	each	10	1	425	425	**
Airblast sprayer-"Myer"	300 gallon high pressure on trailer	each	7	1	3,600	3,600	**
Fertilizer injector	26 gallon injector	each	5	2	858	1,716	**
Transplanter, 2 row	2-42/48" row field transplanter	each	10	1	5,600	5,600	**
U Blade - field	18" for undercutting	each	5	1	240	240	**
Undercutter - bed	Bed undercutter, 50" blade, lift tines	each	7	1	285	285	**
Fertilizer sidedresser	2 row sidedresser	each	10	1	1,000	1,000	**
Cultivator, 2 row	2 row field cultivator	each	7	2	1,750	3,500	**
Wagon	4 wheel, farm wagon	each	10	8	1,978	15,824	1
Cultivator, 3 row	3 row bed cultivator	each	7	1	2,250	2,250	**
Truck	1/2 ton pickup truck	each	5	2	13,485	26,970	2
Pallets	Wooden	each	2	482	12	5,784	**
Handtools	Miscellaneous	sets	5	76	100	7,600	1
Seeder	Broadcast Seeder		10	1	175	175	**

Table 1 Cont.

Mower	7' - 3 blade mower		10	1	2,283	2,283	**
Flatbed Truck	24 ft. flatbed, gas fuel		5	1	42,000	42,000	3
Heating system for propagation							
Gas fired unit heater - Modine	200,000 BTU (input)	each	10	2	1,104	2,208	**
Fan jet - Acme		each	10	2	103	206	**
Thermostat	Two stage	each	10	2	44	88	**
Set-up for propane***	Vent., reg., etc.	each	10	2	100	200	**
Set-up for heating system	Plywood, braces, bolts, etc.	each	10	2	100	200	**
Other propagation materials						1,494	
Misting system	Mist-a-matic	each	2	6	249	494	**
Pipe and nozzles	For misting system		2	2	300	600	**
Treated boards	5/4" x 8" x variable length	foot	2	1,320	0.74	977	**
Heating cable	Propagation	foot	2	3,600	0.35	1,260	**
Subtotal						529,045	38
TOTAL						1,379,236	100

*Total Nursery - 200 acres, 170 acres of growing space, 30 acres production facilities, holding & field bed area, roads, etc.

**Less than 1/2 of 1%.

***Propane tanks, connectors, etc. will be leased from the company supplying propane.